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Donald J.P. Swift, Anthony E. Cok and Anil K. Lyall

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# A Subtidal Sandbody in the Minas Channel, Eastern Bay of Fundy*

DONALD J.P. SWIFT
Puerto Rico Nuclear Center, Mayaguez, Puerto Rico

ANTHONY E. COK
Department of Physics, Adelphi University, Garden City, Long Island, N.Y.

and ANIL K. LYALL
Department of Geology, Dalhousie University, Halifax, N.S.

The Bay of Fundy contains a variety of sandbodies with large-scale bedforms impressed upon them. One of the most striking of these is the Cape Split sand body of the Minas Channel (Figure 1), the body of water which serves as an anteroom separating the Minas Basin from the main Bay of Fundy. It is partitioned off from the Minas Basin by a parabolic, synclinal cuesta of Triassic basalt, with Cape Blomidon at the elbow and Cape Split at the tip of the cuesta. Pleistocene subaerial erosion and Holocene tidal scour have cut a trench through the glacial outwash flooring the Minas Passage (Figure 2), into the underlying Carboniferous sandstones and shales. The trench is locally as deep as 150 metres below sea level. The sandbody occurs on the flat floor of Scot's Bay on the 30-metre-deep lip of the trench, 3.7 km west of Cape Split.

The sandbody has been localized by the interaction of the bottom topography with the tides. Tidal currents, which average 4 km per hour throughout most of eastern Fundy, accelerate to 10 km per hour in the Minas Channel, and have been calculated by photogrammetric methods at 20.4 km per hour in the narrow Minas Passage (CAMERON, 1961). Cameron's studies show that there is a continuous clockwise eddy in Scot's Bay regardless of the phase of the tide, and ship's drift tracks show that this current moves northeastward over the sandbody at 5 to 8 km per hour. During low tide, turbulent zones or overfalls (STEWART and JORDAN, 1965), form over the sandwaves developed on this body.

The sandbody was discovered during a feasibility study for a tidal power dam undertaken by HUNTEC LIMITED of Toronto. They made the continuous seismic profile shown in Figure 3, using a Huntec Hydrosonde sub-bottom profiling system. In this record, sandwaves up to 15 metres in height are impressed on the upper surface of the sandbody. The profile of the sandbody shown in Figure 4 is analogous to an underwater view seen from Cape Split, looking west down the Minas Channel. The flat bottom of Scot's Bay lies on the left, and the Minas Channel scour trench drops off on the right. The sandbody is a plano-convex mass resting on a substrate of outwash sand and gravel, asymmetrical toward the scour trench.

Four distinct zones may be seen (Figure 4). On the southern side are the large, well-defined sand waves seen in Figure 3; these features

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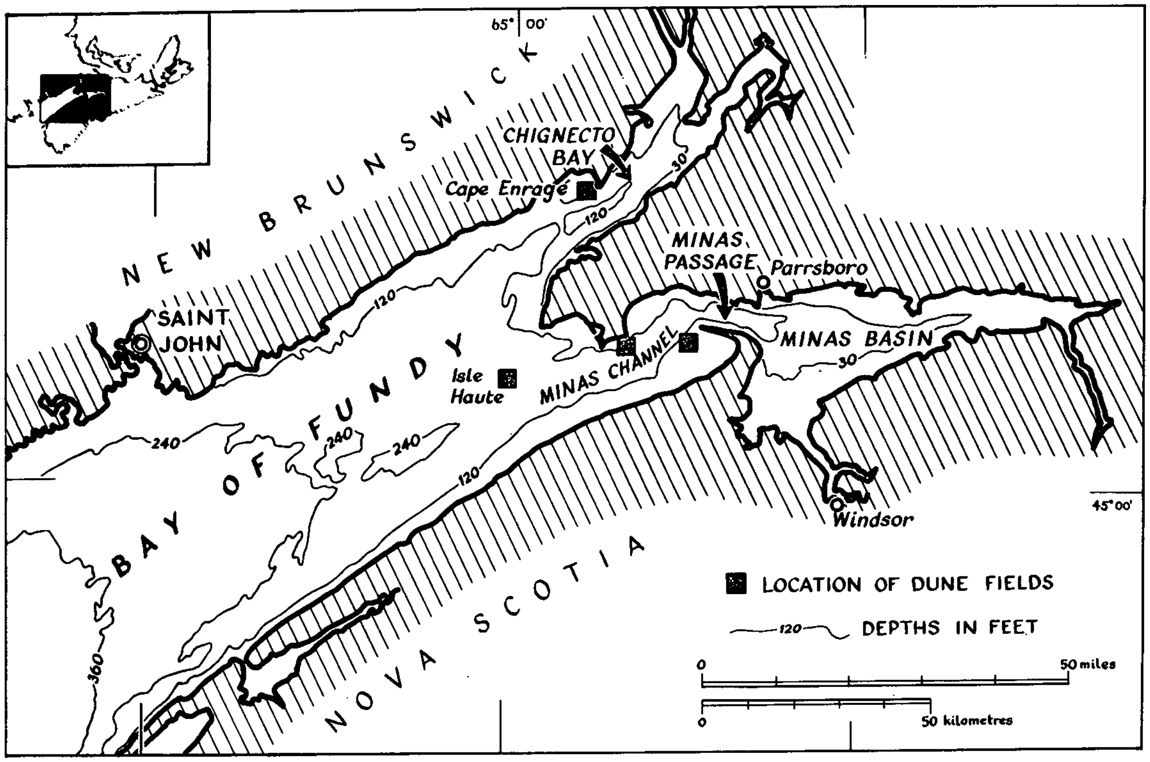


Figure 1. Sand wave (dune) fields in the Bay of Fundy.

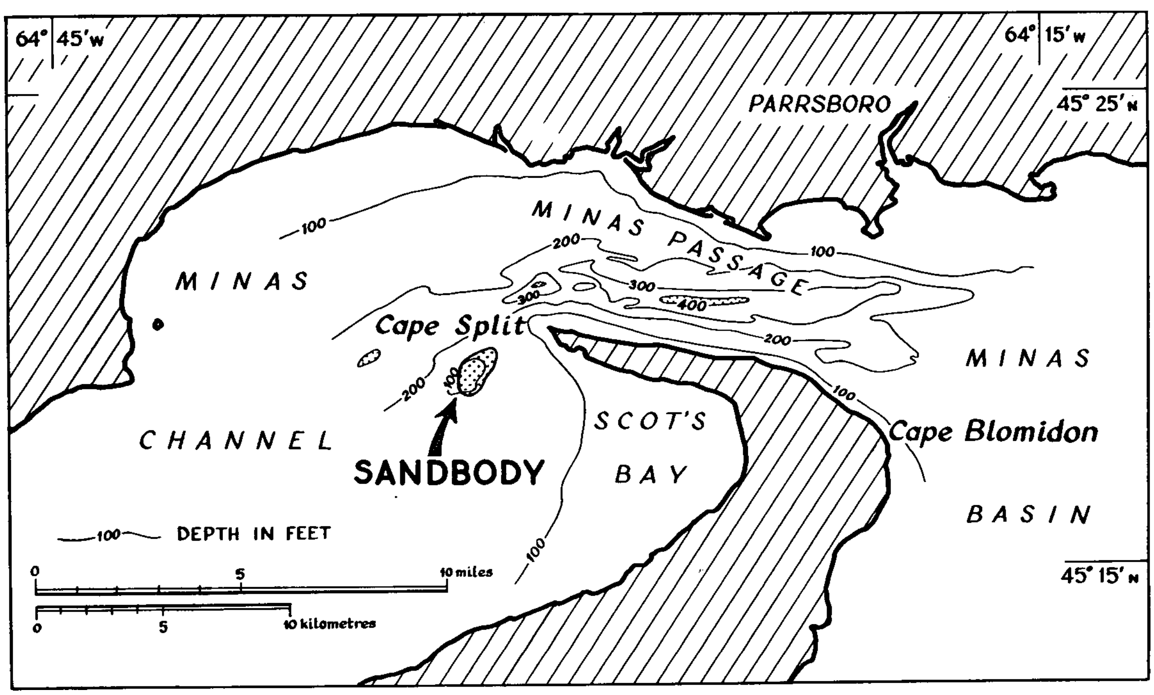


Figure 2. Bathymetry in the Minas Passage area and location of the Cape Split sand body. Data from Huntec Limited, Toronto.

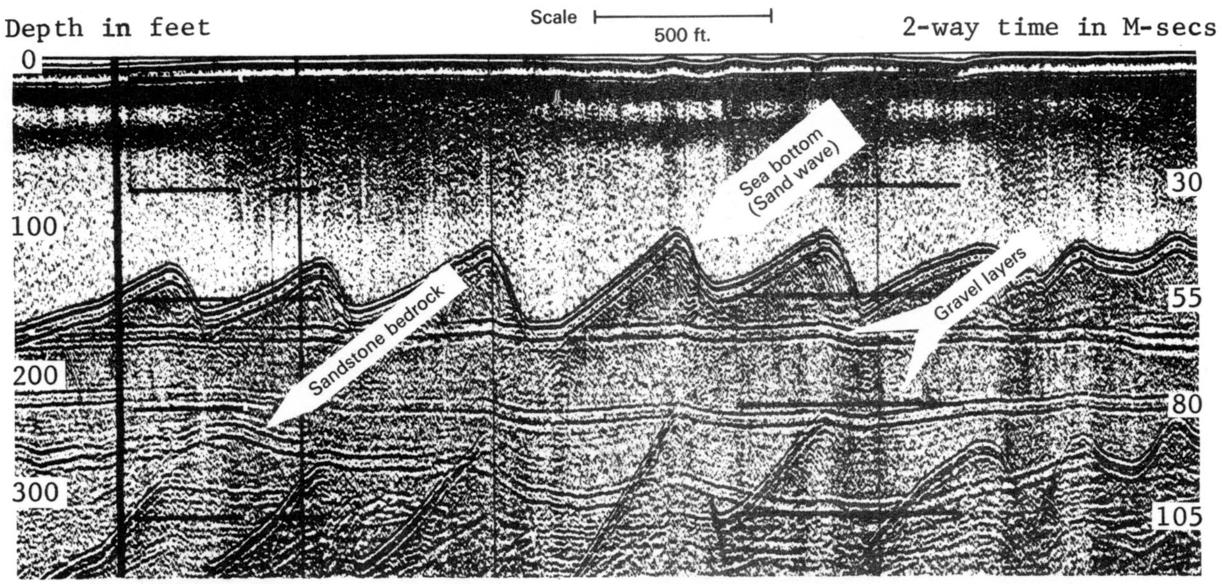


Figure 3. Sub-bottom profile, south side of Cape Split sand body; reproduced from Hydrosonde records, courtesy of Huntec Limited, Toronto.

are 10 to 15 metres high with wavelengths of 150 to 180 metres, yielding an average quotient of 12. JORDAN (1962) has presented a table citing 29 examples of sand waves from rivers and shelves around the world; his smallest quotient is 25, and these are "surimposed" waves from Georges Bank. His most common quotients are 40 to 60. However, HARVEY (1966) has reported large symmetrical sand waves from the Irish Sea with form quotients of around 12. On the south side of the Cape Split sandbody, gravel substrate is exposed at one point (Figure 3) between the waves: the rates of sediment removal and supply must be nearly balanced. VAN VEEN (1935) called this sharp-crested asymmetrical pattern "progressive waves", and attributes it to unidirectional flow.

A second zone of sand waves occurs towards the crest, where the sandbody thickens and the bedforms are less regular. Here they appear to be riding up each other's back. Beyond a third, crestal, zone of symmetrical sand waves is a fourth zone of smaller, regular waves with reversed asymmetry. On some records, the troughs are much more rounded than the crests, a pattern which VAN VEEN (1935) referred to as asymmetrical-trochoidal, attributing it to a reversing current with ebb and flood of unequal strength. The current profile in Figure 4 was obtained with a Kelvin Hughes Direct Reading Current Meter, lowered with a 25 kg lead weight. The profile shows current varying from 1.0 to 2.4 km per hour (0.6 to 1.3 knots) at two hours before low tide. Flow direction has only a $20^{o}$ range, but current intensity varies markedly with depth, indicating large scale vertical turbulence. Unfortunately, the anchor was lost at this station, and it was not possible to run further profiles. However, a hypothetical current pattern deduced from bedform asymmetry is sketched

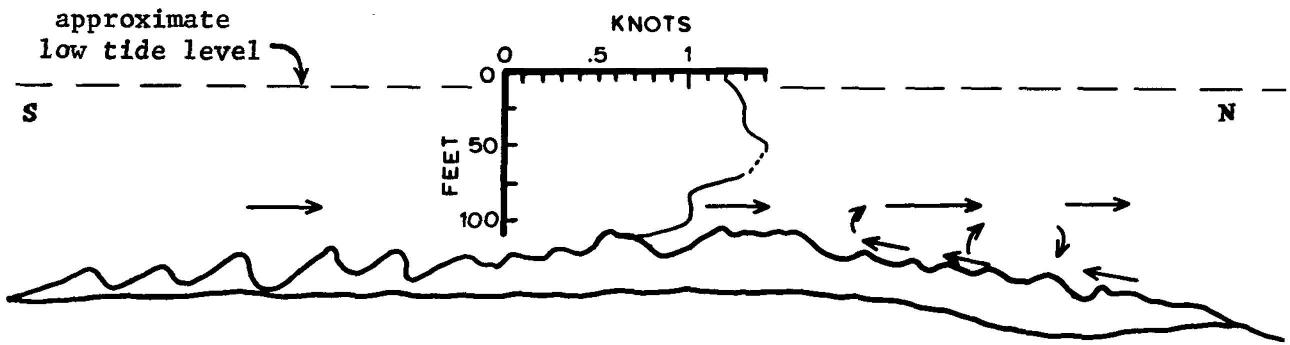


Figure 4. Profile of the Cape Split sand body from south to north, from hydrosonde data, showing the interpreted current system during ebb. The current profile was taken about two hours before low tide.

in dashed lines. The pattern includes a large horizontal eddy in the lee of the crestal area.

The outline of the sand body shown in Figure 2 is based on eight profiles. Those taken on the M/V Calabogie cruise are accurately positioned to within 100 feet by virtue of a high-precision Decca system; those of the CNAV Sackville cruise were positioned by radar. A systematic error in the Sackville data prevents the drawing of crest-lines and the calculation of the rates of sand-wave movement; it is inferred, however, that the north-side and south-side sand wave systems are parallel to the sandbody crest.

Figure 5 presents an interpretation of the current system responsible for the sand body. The south side has been molded in response to the non-reversing Scot's Bay tidal gyre. The north side has been shaped by an eddy in the lee of the crest. The eddy is driven by the main current overhead, and also by the reversing tidal stream of the adjacent scour trench, shown here in flood. While the south side sand waves are always perpendicular to

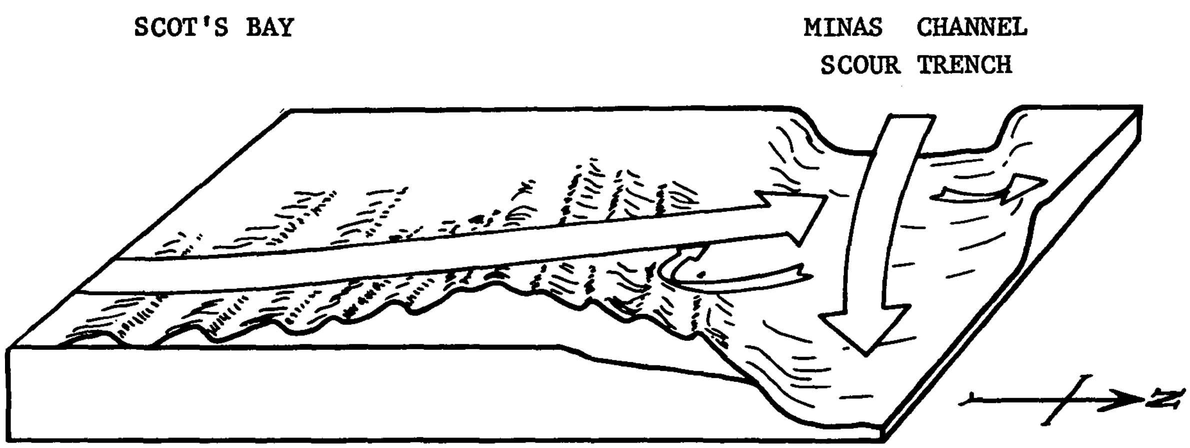


Figure 5. Interpretation of the current system responsible for the Cape Split sand body, shown during flood tide.

the current, the north side sand waves are crossed obliquely by a northwest counter current on the flood tide, and a southwest counter current on the ebb.

The Cape Split sandbody has been localized by the interaction of a high velocity tidal stream with a scour trench and a cape. This set of features occurs again, off Cape Spencer in the Minas Channel, and hydrosonde records show that a sandbody exists there also. The sandbody is smaller, but shows a similar reversal of sand wave asymmetry across its crest. Hydrosonde records suggest that sandbodies of possibly similar origin exist off Isle Haute in outer Fundy, and off Cape Enragé in Chignecto Bay.

Petrographic studies of the Cape Split sands are presently being undertaken in order to determine the nature of their textural adjustment to the current regime.

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